STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
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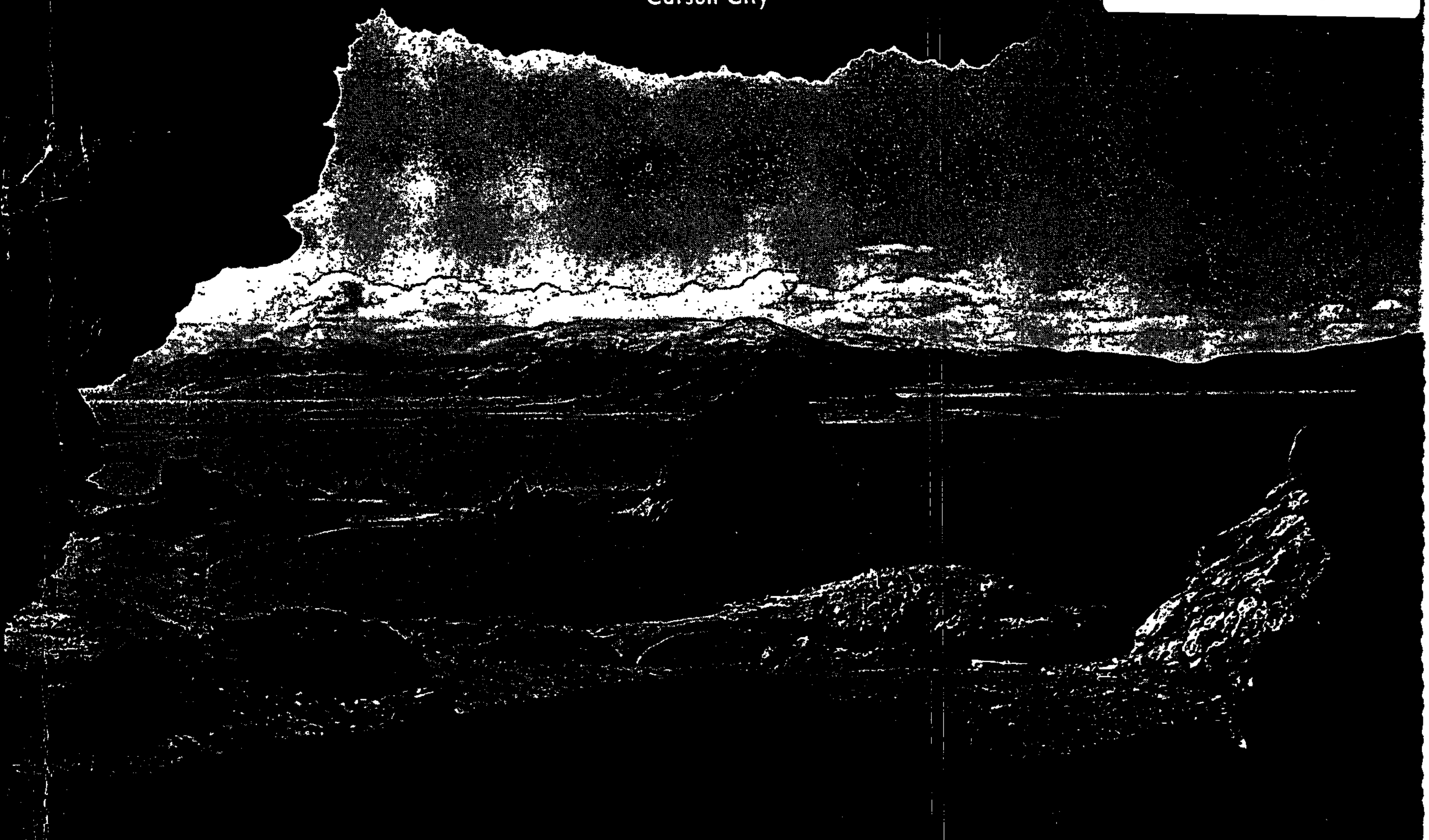

WATER RESOURCES—RECONNAISSANCE SERIES
REPORT 57

A BRIEF WATER-RESOURCES APPRAISAL OF THE TRUCKEE RIVER BASIN, WESTERN NEVADA

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INTRODUCTION

Purpose and Scope of the Study

Ground-water development in Nevada has increased substantially in recent years. A part of this increase is due to the effort to bring new land into cultivation. The growing interest in ground-water development has created a substantial demand for information on ground-water resources throughout the State. Recognizing this need, the State Legislature enacted special legislation (Chapter 181, Statutes of 1960) authorizing a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U.S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources, Division of Water Resources. This is the 57th report prepared as part of the reconnaissance studies (fig. 1 and p. 117).

In the early studies, little information on the surface-water resources was presented. Later, this reconnaissance series was broadened to include a preliminary quantitative evaluation of surface water in the valleys studied.

The objectives of this brief reconnaissance are to (1) describe the hydrologic environment, (2) appraise the source, occurrence, movement, and chemical quality of water in the area, (3) estimate average annual potential recharge to the ground-water reserviors, (4) evaluate the surface-water resources of the valleys, (5) provide preliminary estimates of stored ground water, (6) estimate present water development in the area, and (7) evaluate the gross water resources of the several hydrographic areas. Most of the hydrologic field work for this report was done by the authors between July 1969 and April 1970.

Location and General Features of the Area

The study area lies near the western edge of the Great Basin, along the Nevada-California State line (lat 39°10'-40°25' N., long 119°-120° W.; see fig. 1), and encompasses 12 hydrographic areas (table 2). Eleven of the areas lie in the Truckee River basin[1/], and the 12th, the Fernley Area, borders the basin to the east. Within the Truckee Canyon Segment, along the State line, two areas with different western boundaries are discussed in this report. The first includes all drainage in Nevada that is tributary to the Truckee River; for this area, the western boundary is the State line. The second

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1. The only part of the Truckee River basin in Nevada not included in this study is the Lake Tahoe Basin.

area, which is more convenient for hydrologic budget purposes, includes drainage in both Nevada and California that is tributary to the river downstream from the Farad, California streamflow gage. This area does not include drainage in Nevada that feeds the river above the gage. The relationship of these two areas is shown by the small inset map in the upper right-hand corner of plate 1.

The overall area studied includes Reno and Sparks, which together boast the second greatest concentration of people in Nevada, with a population of about 100,000. Elsewhere in the study area, population is characteristically sparse, with only a few small towns and settlements--Verdi, Wadsworth, Fernley, Nixon, and Sutcliffe--plus the residents of Sun, Pleasant, and Washoe Valleys, and the unincorporated parts of Truckee Meadows (pl. 1). Outside the commercial-industrial area associated with Reno and Sparks, the principal activity is ranching. The Pyramid Lake Paiute Indian Reservation covers about 600 square miles, including the lake itself, in the northeastern part of the study area (the reservation covers an additional 140 square miles outside the study area).

Other Studies and Data Related to Hydrology

Several parts of the present study area have already been evaluated to various degrees from a hydrologic standpoint. Selected recent reports discuss the following major areas (see "References" section for complete titles):

Entire Truckee River basin (Pyramid Lake Task Force, 1969, 1971)
Fernley-Wadsworth area (Sinclair and Loeltz, 1963)
Lower Truckee River basin (Clyde-Criddle-Woodward, Inc., 1968; Wilsey & Ham, 1970)
Pyramid Lake (Harris, 1970; Harding, 1965)
Spanish Springs, Sun, and Warm Springs Valleys (Rush and Glancy, 1967)
Steamboat Springs area (White, 1968)
Truckee Meadows (Cohen and Loeltz, 1964; Guyton & Associates, 1970)
Washoe Valley (Rush, 1967)
Winnemucca Lake Valley (Zones, 1961)

Basic water-resources data for the study area are listed in several Geological Survey report series. Streamflow and lake-level records through 1965 are summarized in Water-Supply Papers 1314, 1734, and 1927. Records after 1965 appear in annual publications titled, "Water resources data for Nevada" (1965-69). Water-quality data for streams are published in the annual summaries titled "Water quality records in Idaho and Nevada, 1964," and "Water resources data for Nevada" (1965-69). Ground-water levels through 1965 are published in Water-Supply Papers titled "Ground-water levels in the

United States; southwestern States" (the most recent of which is no. 1855).

Reports that inventory water use and water resources in Nevada (Nevada Division Water Resources and U.S. Geological Survey, 1971 a and b) include data for the study area. Other reports of hydrologic interest are included in the section titled "References".

Several current (1971) groups and activities pertinent to hydrology of the study area are:

1. The Department of Interior Committee on Operating Criteria and Procedures, Truckee and Carson River Basins, has developed procedures to minimize the diversion of water from the Truckee River in the operation of the Newlands Project.

2. The State-Federal Pyramid Lake Task Force has investigated methods of stabilizing the lake level; their final report was released in December 1971 (see "References").

3. A Type I Comprehensive Framework Study for the Great Basin Region has been completed and presented in a series of reports prepared by a work group within the Pacific Southwest Inter-Agency Committee.

4. A hydrologic simulation model of the Truckee River basin is being developed by the Center for Water Resources Research, Desert Research Institute, University of Nevada. An outgrowth of this study is the report by Cooley and others (1971), which was released after completion of this Geological Survey reconnaissance report.

5. An investigation of water and related land resources and problems in the Truckee River basin is being made as part of the U.S. Department of Agriculture's Central Lahontan River Basin Survey. First report issued is by U.S. Forest Service and U.S. Soil Conservation Service, 1970 (see "References").

Acknowledgments

Many individual well owners throughout the report area provided helpful information. In addition, C. T. Snyder and R. E. Smith of the U.S. Geological Survey provided valuable data on well and spring locations and ground-water quality. Likewise, Eldon Dobyns and R. S. Leighton of Sierra Pacific Power Co., James Long of the U.S. Bureau of Indian Affairs, Dick Holland and Jim Schalnus of the U.S. Bureau of Land Management, P. R. Taylor of the U.S. Bureau of Reclamation, and H. E. Winchester of the State Engineer's Office contributed important information on wells and water use. The help of all these people is greatly appreciated.

GENERAL HYDROLOGIC ENVIRONMENT

Physiographic Setting

The report area is dominated to the west by the lofty Sierra Nevada, and to the east by starkley beautiful Pyramid Lake (pl. 1). The two are linked by the Truckee River, which flows eastward from the State line to Wadsworth, then northward to the lake--a total distance of about 90 river miles, with a drop in altitude of more than 1,200 feet. This reach of the river drains a system of generally north-trending mountain ranges, the highest of which is topped by 10,788-foot Mt. Rose, and valleys, including the populous Truckee Meadows. Small perennial streams, the largest of which is Steamboat Creek, and many ephemeral drainages feed the river in and upstream from the Meadows. Below Vista, all tributaries are ephemeral. The lowest point in the study area, at about 3,460 feet, is the deepest spot in Pyramid Lake. The 170-square-mile desert lake is the largest body of water lying entirely within Nevada. The lake is a remnant of pluvial Lake Lahontan, which covered a maximum area of almost 8,700 square miles in western Nevada and easternmost California during the late Pleistocene epoch, about 50,000 years ago (Morrison, 1965, p. 279; Morrison and Frye, 1965, fig. 2). The huge lake's maximum extent within the report area is shown on the small index map on plate 1.

Table 2 summarizes the physiographic features of the 12 hydrographic areas discussed in this report, and the small map in the upper left corner of plate 1 shows some of the hydrographic relationships among the areas.

Geologic Units

Rocks in the report area can be grouped in three gross geologic units: younger alluvium and older alluvium, which together form the valley-fill ground-water reservoir, and consolidated rocks. This division is based in part on hydrologic properties, though such properties vary widely depending on physical and chemical differences. The surficial extent of the three units is shown on plate 1, and their geologic and hydrologic character is summarized in table 3. The geology shown on plate 1 and summarized in table 3 was in large part adapted from Bonham (1969), Cohen and Loeltz (1964), Moore (1969), Rush (1967), Rush and Glancy (1967), Tatlock (1969), and Willden and Speed (1968).

Criteria for separating the two alluvial units are as follows: Older alluvium characteristically is unconsolidated to semiconsolidated, dissected, and locally deformed; it mostly commonly is exposed on the intermediate slopes between mountains and valley floors. Younger alluvium, in contrast, is generally unconsolidated, undissected, and undeformed; it is largely restricted to the valley lowlands and stream channels (and is generally underlain by older alluvium). In some areas the two units are difficult to distinguish, or their extent is too limited to be shown on plate 1. In such places, the two units are combined, and labeled as either younger or older alluvium, depending on which is thought to dominate.

Valley-Fill Reservoirs

Extent and Boundaries

Alluvium (pl. 1) forms the valley-fill reservoirs, which are the principal source of ground water in the area. The reservoirs beneath the central parts of most of the valley floors probably are at least 500 feet thick, with the valley fill in Truckee Meadows possibly thicker than 4,000 feet (Cohen and Loeltz, 1964, p. S12). Although bedrock reportedly has been encountered in wells at much shallower depths, such wells are near the bedrock-alluvium contact, where the valley fill is generally thin. The general character of valley-fill sedimentary deposits penetrated by wells in the study area is indicated by representative well logs in table 22.

External hydraulic boundaries are formed by the consolidated rocks (pl. 1), which underlie and surround the valley-fill reservoir. These boundaries are leaky to varying degrees. The principal internal hydraulic boundaries are lithologic changes and faults that cut the valley fill. The extent to which these lithologic and structural barriers impede ground-water flow is uncertain in most places.

Occurrance and Movement of Ground Water

Ground water, like surface water, moves from areas of higher head (water-level altitude) to areas of lower head. Unlike surface water, however, it moves very slowly, commonly at rates ranging from a fraction of a foot to several hundred feet per year, depending on the permeability of the deposits and the hydraulic gradient.

In the Truckee River basin, ground water moves from recharge areas in the mountains or on the adjacent alluvial slopes to the lowlands, where the water either is consumed by evapotranspiration or leaves a valley as stream and ground-water outflow. Two other less important "sink" or terminal-discharge areas are the floor of Winnemucca Lake Valley (for streamflow and ground water generated in that valley, plus an occasional small amount of nonconsumed irrigation water from the Nixon area, and Fernley Sink (for streamflow and ground water generated in the Fernley and adjacent Bradys Hot Springs Areas, plus nonconsumed irrigation water and leakage from the Truckee Canal).

Ground-water movement from valley to valley can occur through alluvium or consolidated rocks. There is no firm evidence that sizable quantities of ground water move to, from, or between valleys of the study areas through consolidated rocks. In contrast, intervalley movement by way of alluvium involves every valley of the study area. Estimates of these quantities, though small, are made in the section titled "Subsurface inflow."

Availability of ground water in the several valleys is indicated in a general way in table 21 by well drillers' reports of the depth at which water was first encountered during drilling, by reported well yields, and by the static and pumping water levels in the completed wells.

Fluctuating ground-water levels reflect seasonal and long-term changes in the quantity of stored ground water. Table 26 lists water levels for 13 observation wells in the study area, and figure 2 shows water-level fluctuations for two additional wells. The data indicate both seasonal and long-term trends, but in general, no major long-term changes of ground water in storage have occurred. Of particular interest are minor long-term water-level declines at several of the wells: for example, between April 1959 and March 1970, the water level in well 19/19-24ccc declined about 4½ feet (fig. 2). These trends are substantiated by monthly data collected by Sierra Pacific Power Co. since 1960 from a network of observation wells in the Truckee Meadows (Guyton & Associates, 1970, p. 15). The long-term declines reflect climatic fluctuations, changes in land use and drainage (for example, from largely agricultural to largely urban in parts of Truckee Meadows), and increases in the amount of ground water withdrawn for public supply.

The level of Pyramid Lake declined about 75 feet between 1909 (shortly after completion of Truckee Canal) and 1969, largely as a result of diversion of potential inflow from the Truckee River to areas outside the basin. The lake-level decline has been accompanied by partial dewatering of the peripheral valley-fill reservoir, as evidenced by declining water levels in wells 24/21-15aca, 26/20-26adb, and 28/22-30 bdb, west and north of the lake (table 21). The total quantity of ground water lost from storage during this period is unknown, but may have averaged about 1,500 acre-feet per year.

Neighboring Winnemucca Lake last received appreciable inflow of Truckee River water in about 1910. Between then and about 1940, when the lake finally dried up, the level declined about 80 feet. Just as at Pyramid Lake, the decline caused a partial dewatering of the valley fill, as reflected in the declining water level in well 28/24-7cab, north of the lakebed. The overall quantity of ground water lost from storage at Winnemucca Lake may be of the same order of magnitude as at Pyramid Lake.

Table 21.--Well data

Depth: Depths followed by asterisk were measured by U.S. Geological Survey personnel (in feet below top of casing) at time of water-level measurement; all others are reported depths.

Use: C, commercial; D, domestic; E, exploratory; I, industrial; Ir, irrigation, P, public supply; S, stock; U, unused or abandoned (intended use in parentheses).

Water level: Measurements recorded to tenths or hundredths of a foot were made by U.S. Geological Survey personnel, and represent depth below land-surface datum; most measurements recorded to nearest foot were reported by well driller or owner.

Remarks: C, chemical analysis in table 18; F, depth, in feet, at which water was first encountered during drilling; L, driller's log in table 22, or in reference indicated; O, U.S.G.S. observation well; R, reported well depth when drilled; S, log in files of State Engineer (State log number is indicated); T, length of time between start of pump test and measurement of drawdown, in hours.

Location	Owner	Year drilled or dug	Depth (feet)	Diameter (inches)	Use	Yield (gpm) and drawdown (feet)	Land surface altitude (feet)	Water-level measurement: Depth (feet)	Water-level measurement: Date measured	Remarks
					DODGE FLAT					
21/23-13dcc	Depaoli Bros.	1948	85	6	S	—	4,190	35	11- -48	F=48; S=720; L; C.
								37.4	10-25-61	
								38.1	2-19-70	
21/24-14aac	Ceresola Bros.	1944	344	6	S	5/—	4,330	294?	5- -44	L; C.
-16aca	Helen Marye Thomas	—	>40	6	DS	—	4,010	19.53	2-20-70	C.
-28ddc	W. J. Ceresola, Sr.	Pre-1900	12-14	36	DS	—	4,040	8-10	—	C.
-30dbd	Pyramid Lake Paiute Tribe	—	>180	4?	U(S)	—	4,190	154.0	2-19-70	
-33dcb	do.	1968	470	26-11	I	1200/—	4,120	94	11- -68	S=10404; L; C.
22/23-27dca	Depaoli Bros.	1957	162	6	S	2/—	4,810	150±	—	F=148; S=3948; L.
					FERNLEY AREA (See Sinclair and Loeltz, 1963, p. 16-22, for other well data.)					
19/25-6ccc	Bureau of Land Management	1940	242	6	DS	—	4,470	195	12- -40	C; see WSP 1619-AA.
								199.74	6-10-70	
20/24-11bbd	Nevada Cement Co.	1966	250	12	IP	750/36	4,120	37	1966	T=>48; F=40; L; C.
						1200/63				
-11ccc	Nevada Highway Dept.	—	33	6	I	—	4,151.8	See table 23.		O. See table 23 for specific-conductance data.
-24bbb1	Fernley Water District (well 1)	1958	207	20-8	P	1000/35	4,180	60	1958	F=78; S=4031; L (see WSP 1619-AA).
-24bbb2	do. (well 2)	1965	199	10	P	500/14	4,180	78	5- -65	F=83; S=8508; L; C.
						775/29				
20/25-7bdd	Sav'n Sam's Service Station	1965	206	6	C	—	4,140	36.43	2-20-70	F=68; S=8163; L; C; (water level 62 ft before well deepened from 83 ft).
-18ccc1	Joe Garbarino	—	28	6	U(D)	—	4,133.8	See table 23.		O.
-18ccc2	do.	—	155*	10	U(Ir)	900/45	4,135.2	do.		R=200; O; L; C.
-21acd	John Urizar	1951	212	6	D	—	4,145	23	12- -51	F=25; S=1840; L (see WSP 1619-AA);
								5.50	7-22-53	C.
-23aba	Jack Olson	1960±	60±	6	S	—	4,100	16.76	3- 4-70	C.
-24cad	Edna B. Brush	1950	123	6	DS	60/—	4,165	35	11- -50	F=118; S=1495; L (see WSP 1619-AA);
								40.83	7-22-53	C.
-25adb	Merritt Construction Co.	1965	240*	6	U(I)	—	4,250	170	8- -65	R=258; F=135; S=8672; L; C.
								167.15	3- 4-70	
					PLEASANT VALLEY					
17/19-9abb	John S. Sinai	1952	109	6	D	14/2	6,155	47	6- -52	F=50; S=1960; L.
-11abc	Talcott Griswold	1960	135	6	D	—	5,440	93.5	4- 2-70	F=98; S=5247; L; C.
-17aad	Tannenbaum, Inc.	1964	385	6	P	5/10	7,080	320	11- -64	F=370; S=8280; L; C.
17/20-4bdd	H. O. Shelhamer	1959	37	6	D	—	4,640	1	6- -59	L; C.
-4dc	—	1940	52*	2	—	½/—	4,650	flows	1949	C.
-7aab	C. W. Lingenfelter	1958	168	6	DS	15/8	4,860	102	6- -58	T=1½; F=102; S=4134; L; C.
								108.2	3-24-70	
-7cad	Washoe County School District	1965	150	8	P	80/47	4,830	10	1- -65	T=24; F=18; S=8357; L; C.
-18cca	Merle Benet, Gloria Oberg	1956	290	6	P	—	4,990	195	1- -57	F=235; S=3694; L; C. Serves about 30 people
					PYRAMID LAKE VALLEY					
22/23-1bda	Pyramid Lake Paiute Tribe	1961±	60	6	P	15/—	3,910	—	—	C.
-1ddb	Roy Garcia?	1949	95	6	U(D)	7/—	3,930	30	3- -49	F=50; S=833; L.
22/24-9bad	Ceresola Bros.	1946±	200±	8	DS	—	4,155	125±	—	C.
-13ac	do.	1964	315	6	S	10/0	4,300	287	12- -64	T=2; F=287; S=8350; L; C.
23/21-15bcc	M. K. Hudlow?	1959	308	8	U(I)	—	4,400	35	7- -59	F=45; S=4722; L.
23/22-10cad	B. I. A. test well 2	1963	106	8	U(E)	—	3,927.9	44	11- 4-63	L.
-10dbb	W. R. Abraham	1958	185	6	U(C)	—	3,880	174?	7- -58	S=4496. Water-bearing, 150-185 ft.
23/23-1cac	Bob Irwin	—	32*	12	S	—	3,860	18.09	7-21-70	C. Land-surface datum is terrace 10 ft above well.
-15cad	Gilbert Greene	1964±	>115	6	S	—	3,885	28.84	7-27-71	C.
-23bcb	Harry Winnemucca	1948	136	4	U(D)	8/2	3,895	4	12- -48	T=2; F=12; S=797; L; C.
								4.15	2-19-70	
-25bcd	Pyramid Lake Paiute Tribe	1966	350	8	P	135/7	3,940	47	5- -66	T=24; C; serves about 60 families.
-25cba	do.	1954	287	8	P	40/64	3,945	43	6- -54	F=43; S=2655; L.
-26ddc	Nevada Highway Dept.	1966	170	6	I	21/3	3,940	30	9- -66	T=2; F=30; S=9184; L; C.
								31.58	2-19-70	
-29cab1	Warren Tobey	1962±	10*	48	S	—	3,885	7.22	7-31-69	
-29cab2	do.	1964±	35±	8	D	—	3,885	—	—	C.
-36ddc	Albert Aleck	1965±	50±	8?	D	—	3,910	—	—	C.
24/21-15aac	Fred Crosby	—	110	6	P	—	3,885	—	—	C. Serves 25-50 people.
-15aca	W. L. Pattridge	1955	222	6	D	—	3,900	48	6- -55	F=53; S=6201; L.
								61.99	7-31-69	
-15cad	B. I. A. test well 4	1963	420	8	U(E)	160/114	4,020.7	30?	10-17-63	T=27; F=70?; L; C.
								26.5	9- -67	
								28.81	7-10-70	
24/22-31ccb	B. I. A. test well 3	1963	296	8	U(E)	107/51	3,986.8	42?	12- 6-63	T=48; F=130?. Cased to 190 ft;
								47.0	9- -67	perforated from 130 to 190 ft?
-31ccc	B. I. A. test well 6	1963	226	8	U(E)	171/115	3,985.3	8?	12- 6-63	T=45; F=76?; L; C.
								12.5	9- -67	
								11.3	7-10-70	
24/23-36cba	Ceresola Bros.	1948	73	6	S	—	3,845	22	2- -48	F=22; S=414; L.
								23.65	7-31-69	
								27.14	7-14-70	
25/21-18baa	Nevada Div. of Parks	1968	112	6	U(P)	77/2.6	3,840	34	4- 8-69	T=5; F=49; L; C.
-32aaa	B. I. A. test well 5	1963	397	8	U(E)	dry(?)	3,984.8	dry(?)	1963	L.
25/22-2dcc	Pyramid Lake Paiute Tribe	—	6½*	48	S	—	4,034	3	5- 1-50	C; well may bottom on bedrock.
								2.76	7-21-70	
26/20-12abc	Western Geothermal, Inc.	1966	1,206	10-5½	U(E)	—	3,800	flows	8- 5-71	Temp. 205°F at 550 and 850 ft, 202°F at 1,155 ft.
-26adb	Southern Pacific Co.	—	210*	8	U(IP)	80/—	3,900	22	about 1914	
								98.28	2- 4-70	Layer of oil atop water; L; C.
								96.83	7-10-70	
26/21-6ccb	Western Geothermal, Inc.	1964	5,930	16-7	U(E)	7/0	3,815	flows	2- 4-70	L; C.
-6ccc	do.	1966	1,488	10-5½	U(E)	—	3,825	a few	1-29-66	Max. down-hole temp. 245°F.
27/20-28bbc	Pyramid Lake Paiute Tribe	1958	135	6	U(S)	20/—	3,994	35	11- -58	F=115; S=4425; L.
-29bac	Mrs. A. V. Heller	1961±	—	6	S	—	4,009	24±	2- 4-70	C.
27/21-9bda	U.S.G.S. test well 2	1967	47*	2	U(E)	—	3,845	See table 23.		O. Cased to 47 ft, screened 45-47 ft.
-16abd	U.S.G.S. test well 1	1967	44*	2	U(E)	—	3,837	do.		O; L; C.
28/21-33ccd	U.S.G.S. test well 3	1967	60*	2	U(E)	—	3,865	do.		O; L; C.
28/22-30bcb	Pyramid Lake Paiute Tribe	1930's	420+*	4	U(S)	—	4,245	400	1939?	R=482; C.
								dry at 420	8- 5-71	

Table 22.—Well logs—Continued

Material	Thickness (feet)	Depth (feet)
20/22-35aba (cased to 150 ft; perforated from 64 to 150 ft)		
Dirt and large boulders	28	28
Hardpan	18	46
Gravel and clay, water-bearing	6	52
Clay, brown	30	82
Gravel and some clay, water-bearing	14	96
Clay, brown	4	100
Gravel, water-bearing	4	104
Clay, brown	18	122
Gravel, water-bearing	4	126
Clay, brown	9	135
Gravel, water-bearing	2	137
Hardpan	13	150
20/23-19ca (cased to 47 ft; perforated from 42 to 47 ft)		
Topsoil, sandy, and boulders	8	8
Sand and boulders, water-bearing	13	21
Clay, sandy	23	44
Sand, water-bearing*	3	47
Clay, sandy	3	50
20/23-21daa (cased to 44 ft)		
Topsoil, sandy	5	5
Clay, sandy, hard	19	24
Clay and rock	14	38
Rock, broken, water-bearing	4	42
Volcanic rock, hard, brown	13	55
Volcanic rock, red	1	56
Volcanic rock, hard, brown, water-bearing	20	76
20/24-11bbd (cased to 250 ft; perforated from 150 to 250 ft)		
Sand	40	40
Sand, fine, and light brown clay	20	60
Clay, sandy, light blue	15	75
20/24-11bbd—Continued		
Sand and pea gravel	15	90
Clay, blue, with streaks of fine sand	15	105
Clay, blue	35	140
Sand, black, with pea gravel; water-bearing	20	160
Sand, hard, water-bearing	10	170
Clay, hard, brown	15	185
Sand, coarse, black, with streaks of clay; water-bearing	35	220
Clay, hard	10	230
Sand and gravel; water-bearing	25	255
20/24-18bca (uncased; insufficient water)		
Sand	6	6
Sandstone	30	36
Sand, gravel, and boulders	29	65
Basalt	130	195
20/24-24bbb2 (cased to 199 ft; perforated from 76 to 196 ft)		
Soil	2	2
Sand and gravel	8	10
Clay	31	41
Gravel	4	45
Clay	11	56
Gravel, rock, and clay	27	83
Gravel, water-bearing	21	104
Clay, sandy	2	106
Gravel, coarse, water-bearing	6	112
Clay	3	115
Gravel and rock; water-bearing	9	124
Clay	41	165
Gravel and clay; water-bearing	9	174
Clay, brown	10	184
Gravel, water-bearing*	13	197
Clay	2	199

Table 22.—Well logs—Continued

Material	Thickness (feet)	Depth (feet)
20/25-7bdd (original hole cased to 83 ft; perforated from 68 to 75 ft. Well later deepened to about 206 ft)		
Topsoil and sand	6	6
Sand, loose	20	26
Clay, brown	42	68
Sand, loose, water-bearing	10	78
Clay, brown	5	83
No record	123	206
20/25-18ccc2 (log approximate, from owner's memory)		
Clay	28	28
Gravel, water-bearing (good quality)	12	40
Clay	108±	148±
Gravel, water-bearing (poor quality)	12	160±
Clay	40±	200±
20/25-25adb (cased to 258 ft; perforated from 130 to 150 ft and 220 to 240 ft)		
Sand, gravel, and boulders	30	30
Clay, gray	86	116
Clay, green	4	120
Clay, sandy, brown	15	135
Clay, yellow, water-bearing*	4	139
Clay, brown, water-bearing*	16	155
Clay, gray	33	188
Clay, gray, and loose rock	30	218
Clay, sandy, brown, water-bearing	15	233
Hardpan, sandy, water-bearing	13	246
Clay, brown	12	258
21/23-13dcc (cased to 85 ft; perforated from 50 to 85 ft)		
Clay	44	44
Rock and clay	4	48
Gravel, water-bearing	37	85

Material	Thickness (feet)	Depth (feet)
21/24-14aac		
Sand	13	13
Rock, gray	29	42
Rock with a little clay	34	76
Lava	19	95
Lava, red	18	113
Rock, hard, gray	2	115
Rock, hard, brown	16	131
Lava, red	15	146
Lava, hard, blue	15	161
Rock, hard, gray, with some red rock below 190 ft	49	210
Lava, red, medium-hard	15	225
Lava, red, hard	7	232
Lava, red and black; water-bearing below 300 ft(?)	76	308
Lava, hard, red, porous, water-bearing	30	338
Rock, hard, black, water-bearing	6	344
21/24-33dcb (cased to 465 ft, perforated in 8 places between 240 and 455 ft)		
Sand, loose	3	3
Gravel, silt, and sand	7	10
Sand, medium, and small gravel	13	23
Sand and gravel	22	45
Sand with gravel stringers	35	80
Sand and gravel with gray clay stringers	12	92
Gravel, medium, with silty sand stringers	9	101
Sand with tight gravel stringers	11	112
Gravel, tight and hard	25	137
Sand with stringers of tight gravel and gray clay	11	148
Clay, sandy, gray	7	155
Clay, gray	3	158
Sand, medium, and gravel	8	166
Clay, blue	13	179

(continued)